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Technical Report 637

Projecting Attrition by Military Occupational Specialty

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Manpower and Personnel Policy Research Group
Manpower and Personnel Research Laboratory

U. S. Army
Research Institute for the Behavioral and Social Sciences

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This research analyses the attrition rates of various enlisted personnel groups within different Army job assignments. Three regression equations are developed in order to project the attrition rate of eight demographic groups to 76 Military Occupational Specialties (MOS). Education, sex, AFQT, along with MOS assignment are the independent variables. The rates generated by these equations show where important tradeoffs exist with respect to personnel allocation and the expected rate of attrition.

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FOREWORD

The Manpower and Personnel Policy Research Group of the Army Research Institute for the Behavioral and Social Sciences is concerned with developing better methods of allocating applicants to Army jobs to utilize Army personnel resources more efficiently. This research is another step in the ongoing process of investigating the various tradeoffs involved in the allocation of personnel to jobs. More knowledge about these tradeoffs may lead to improvements in current assignment systems or the development of new and more efficient ways of assigning personnel.

EDGAR M. JOHNSON
Technical Director

PROJECTING ATTRITION BY MILITARY OCCUPATIONAL SPECIALTY

EXECUTIVE SUMMARY

Requirement:

To be able to project variation in the rate of attrition of various demographic groups within different Military Occupational Specialties (MOS) using data available at the time of enlistment. The rates developed here can be used in deriving costs for optimization models or in the evaluation of policy alternatives.

Procedure:

Using a multiple regression procedure and a longitudinal accession file, MOS-specific attrition rates were developed for 76 MOS across 8 demographic groups. Education, sex, and the Armed Forces Qualification Test (AFQT) scores were used to define the 8 demographic groups.

Findings:

Historical attrition rates can be explained using data available at the time of enlistment. The results show that 67 of the 76 MOS used in this research have variations in the rate of attrition greater than 20% depending on what group is assigned.

Utilization of Findings:

This research shows that alternative policies in assigning enlistees to jobs may lead to a reduction in overall first-term attrition. This reduction in attrition may have a profound impact on force structure and overall Army readiness.

PROJECTING ATTRITION BY MILITARY OCCUPATIONAL SPECIALTY

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I. INTRODUCTION

The retention behavior of enlisted personnel is one of the central concerns of manpower and personnel planning in the military. While all organizations are concerned with maintaining adequate levels of qualified and trained personnel, the military faces the unique situation of contracting individuals for a specified term of service. As a result, individuals leaving prematurely cannot be easily replaced by skilled personnel. Also, among the enlisted ranks, senior level positions (NCO's) are filled by those who have begun their careers in the military at the "lowest" levels. Therefore, the rate of first term attrition/retention affects the future composition and quality of the enlisted force.

Most of the attrition research has emphasized either methods to screen applicants or socio-military factors influencing attrition. This research will examine attrition rates as a function of job assignment characteristics and characteristics of the individual that are known at the time of job enlistment. If there is variability in attrition for demographic groups within different job assignments, then the overall retention rate could be increased without altering both the composition of accessions and changing the numbers of individuals assigned to various MOS. To investigate whether changes in allocation policies can alter the overall attrition rate, certain questions must be answered. Can attrition rates be predicted accurately using data available at the time of job assignment? Can variation within MOS attrition be explained by sex, AFQT Group, and education? Is variation within differential rates large enough to present sizable tradeoff opportunities?

Therefore the objectives of this research are to:

- o predict accurately the percentage of first tour attrition
- o explain variability in attrition within MOS
- o identify sizable tradeoffs that can influence assignment policies

Section II of this research will describe relevant past research. Section III will explain how this paper relates to past attrition research, explain the data used, and the methodological approach taken. Sections IV and V will explain the specific equations used and their results. Section VI will compare the results. Conclusions are presented in Section VII.

II. BACKGROUND

Interest in attrition has increased considerably in the years following the inception of the All Volunteer Force (AVF) (Goodstadt and Yedlin 1980). Much of the interest in attrition has been generated due to the high costs associated with premature separation. During fiscal years 1974 through 1977 the General Accounting Office (GAO) estimated that attrition in the military costs the goverment 5.2 billion dollars in veterans unemployment and compensation (Comptroller General, 1980). Most of the GAO recommendations were concerned with changes in management practices and policies. Such changes were, improved management information systems, the developement of systematic approaches in developing and evaluating personnel policy, and a more definitive system of criteria for discharge. Also emphasized in this report, is the importance of abolishing attrition goals and ceilings.

In general, Wiskoff, Atwater and Houle (1980) classify attrition research into four areas:

1. Selection - prediction, accessioning personnel, accessioning process and societal influences
2. In-Service Concerns - individual variables, organizational practices and organizational change
3. Attrition Decisions - attritees, exit information, societal influences and organizational decision-making
4. Methodological - theoretical models, optimum attrition rates, economics of attrition, statistical analysis and the role of behavioral scientists

The approach taken in this paper is comprised of two topics from the above outline. These topics are prediction and accessioning process, from the selection area, and statistical analysis under the methodological area.

One concern in attrition research is the distinction between causal analysis and descriptive analysis. Siebold (1981) emphasises the difference between the "cause of attrition" and "variation" in attrition and points out that many researchers substitute the word cause when actually they are explaining variation. This research focuses on variation in the percentage of attrition by MOS, AFQT Group, Sex, and Education. This is not a causal analysis. When observable differences occur between groups no attempt will be made to determine "why" there are differences.

Since the word attrition will be used throughout this analysis, it is important to develop a precise definition. Siebold describes four generic definitions of attrition (1981, p. 1100):

1. Attrition - the reduction in the number of personnel of a specified category through separation (the process).
2. Amount of Attrition - the number of personnel of a specified category lost through separation. (The count rather than the process).
3. Rate of attrition - the number of personnel of a specified category lost through separation within a specified period of time. (count/time)
4. Percentage of attrition - the number of personnel of a specified category lost through separation compared to the total population of which the specified category is a primary part.(count/population)

Attrition in this paper can be interpreted as the percentage of attrition (although it may also be called the rate of attrition by the authors.)

To put this analysis within a structural paradigm it is important to understand the broad hypotheses regarding the nature and causes of attrition. Goodstadt and Yedlin (1980) offer several areas of thought regarded as being prevalent in attrition research:

- o The "cause" of attrition resides in the individual.
- o The "causes" of attrition lie in the nature of the organization.
- o The hypothesis that attrition is a function of both the individual and the organization.

Goodstadt and Yedlin suggest certain individual and background factors that have been shown to be related to attrition (individual cases):

- o Reading Ability
- o Education
- o High school experiences, self image
- o AFQT and ASVAB Scores
- o Demographic characteristics

Research in the Navy by Guthrie, Lakota and Matlock (1978) showed that sailors who discharge early are likely to be young, white, have one or more dependents, have less then ten years of education, and to be in the highest mental categories.

Research by the Rand Corporation found that age, education and marital status were significant determinants in the level of post training attrition (Buddin, 1981). Buddin examined Air Force and Army enlisted personnel. Although this work was not MOS specific, it did use five (5) broad occupational areas.

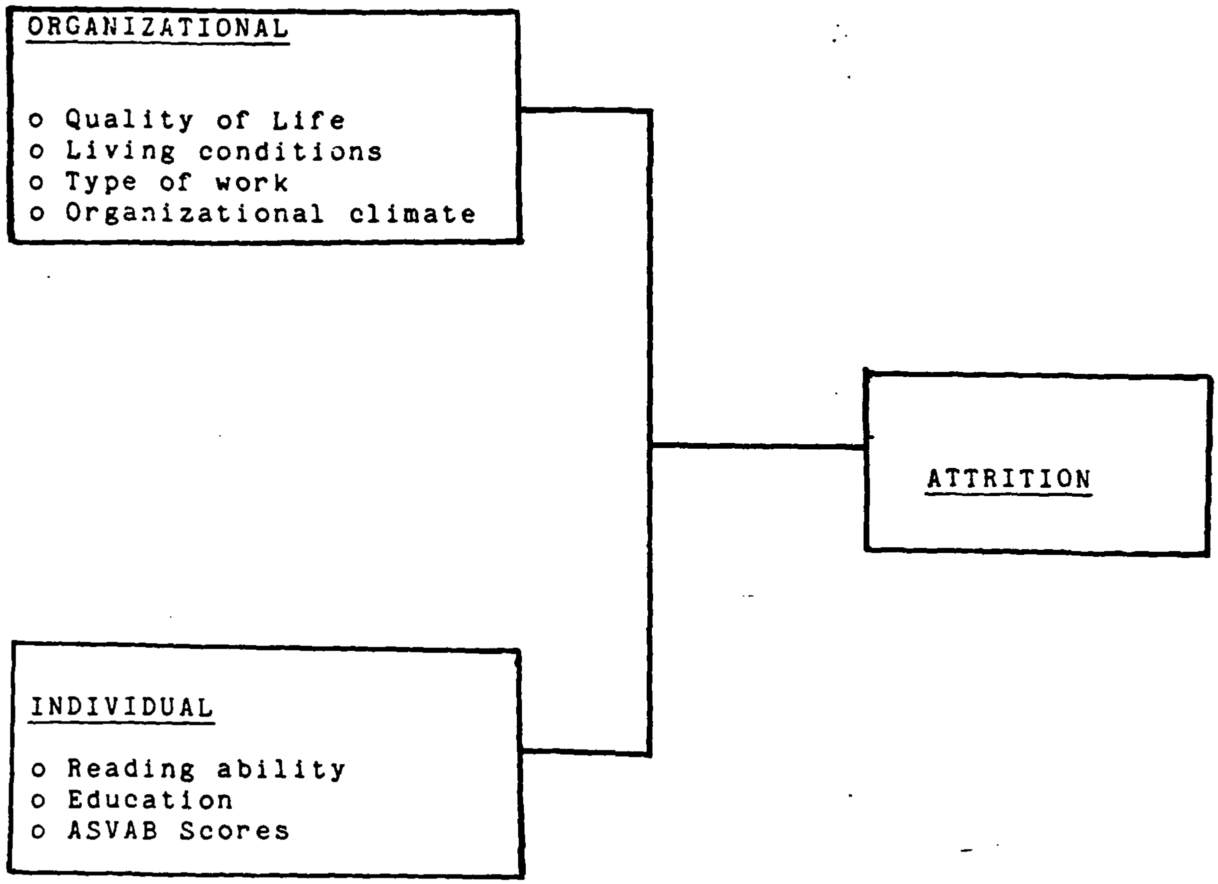
In the mid 1970's research began to place greater emphasis on the relationship between organizational factors and attrition (Goodstadt and Yedlin 1980, p. 27). Factors such as quality of lifestyle, living conditions, variety and control of work, organizational climate and disconfirmation of expectations have been seen as possible determinants of attrition. Other factors such as training and job mismatch, characteristics of leaders and occupational experiences are also offered as possible organizational causes of attrition.

III. APPROACH

This research takes the perspective that attrition is a function of both organizational factors, individual factors and their interaction. The simple input/output model in Figure 1 shows this relationship.

Figure 1

I/O Model of Attrition



An individual's Military Occupational Specialty (MOS) will be used as a surrogate for organizational factors. While not covering all aspects of the organization, MOS does represent much of the lifestyle, living conditions, variety of work, and the occupational experiences associated with the Army.

On the individual side, AFQT group, sex and education are used as attrition predictors. The most important aspect of this research is that it is MOS-specific in examining attrition rates. Also, all variables used are available at the time an individual is assigned to an occupation at the Military Enlistment Processing Station (MEPS). The model accounts for interaction between organizational and individual factors, represented by the dotted line. Other research points to the importance of allowing for this interaction when researching military attrition (Wiskoff, Atwater and Houle 1980, p. 22).

Using Defense Manpower Data Center data (DMDC) resources, a longitudinal data base was developed (Cohort 76/78). The data used are comprised of non-prior service accessions who entered the Army between January 1976 and September 1978. These data have been further refined to improve their reliability for analysis. First, those cases where ASVAB 5 (Armed Services Vocational Aptitude Battery) or ACB 73 (Army Classification Battery) were used have been eliminated from the data. Also, the data have been "cleaned" to the extent that miscoded test scores have been eliminated. To avoid cell size problems, 76 of the larger MOS are used in this analysis. These 76 MOS represent nearly 90% of the total non-prior service accessions and are shown in Table 1.

Table 1

Attrition Sample Size (N) by MOS

MOS	Descriptive Title	N
05B	Radio Operator	394
05C	Radio Teletype Operator	545
05G	Signal Security Specialist	80
05H	EW/Signal Morse Interceptor	298
05K	EW/SIGINI NON-MORSE Interceptor	188
11B	Infantryman	23325
12B	Combat Engineer	5799
12C	Bridge Crewman	1391
12E	Atomic Demolition Munitions Specialist	415
13B	Cannon Crewman	9109
13E	Cannon Fire Direction Specialist	2416
15D	Lance Missile Crew Member	632
15E	Pershing Missile Crewmember	880
16B	Hercules Missile Crewmember	1470
16J	Defense Acquisition Radar Operator	464
16P	A.D.A. Short Range Missile Creman	2416
16R	A.D.A Short Range Gunnery Crewman	977
17C	Field Artillery Targe Acquisition Speciali	640
17K	Ground Surveillance Radar Crewman	1286
27E	Tow/Dragon Repairer	450
31E	Field Radio Repairer	377
31M	Multichannel Communication Equipment Operat	2439
31N	Tactical Circuit Controller	334
32D	Station Technical Controller	187
33S	EW/Intercept Systems Repairer	304
36C	Wire Systems Installer/operator	1249
36K	Tactical Wire Operations Specialist	4401
41C	Fire Control Instrument Repairer	79
43E	Parachute Rigger	763
45K	Tank Turret Repairer	476
51B	Carpentry and Masonry Specialist	250

51K	Plumber	128
52C	Utilities Equipment Repairer	132
52D	Power Generation Equipment Repairer	712
54E	NBC Specialist	557
55B	Ammunition Specialist	524
55G	Nuclear Weapons Maintenance Specialist	305
57H	Terminal Operations Coordinator	301
61B	Watercraft Operator	138
62B	Construction Equipment Repairer	1115
62E	Heavy Construction Equipment Operator	194
62F	Lifting and Loading Equipment Operator	167
63G	Fuel and Electrical Ssytems Repairer	430
63H	Track Vehicle Repairer	1625
64C	Motor Transport Operator	7107
67N	Utility Helicopter Repairer	731
67U	Medium Helicopter Repairer	403
67V	Observation/Scout Helicopter Repairer	686
67Y	Attack Helicopter Repairer	869
71C	Stenographer	291
71D	Legal Clerk	89
*71L	Administrative Specialist	65
71M	Chapel Activities Specialist	162
71N	Traffic Management Coordinator	95
73C	Finance Specialist	543
75B	Personnel Administration Specialist	2100
75C	Personnel Management Specialist	115
75D	Personnel Records Specialist	1047
75E	Personnel Actions Specialist	253
76J	Medical Supply Specialist	383
76P	Material Control and Accounting Specialist	1059
76V	Material Harbling and Storage Specialist	600
76W	Petroleum Supply Specialist	1240
76Y	Unit Supply Specialist	3399
82C	Field Artillery Surveyor	1731
91B	Medical Specialist	6322

91C	Patient Care Specialist	367
91D	Operating Room Specialist	739
91E	Dental Specialist	303
91P	X-Ray Specialist	291
91Q	Pharmacy Specialist	258
91R	Veterinary Specialist	107
94B	Food Service Specialist	7304
95B	Military Police	8249
98C	EW/SIG INT Analyst	546
98G	EW/SIGINT Voice Interceptor	511
		Total N = 118,262

*(Note: 71B should have been used instead. 71B was the largest clerical MOS in the years used in this analysis. Currently 71L has the greater number of enlistees.)

Using a sample of 76 MOS, accounting for 118,262 accessions, the following sets of equations are developed.

- o The MOS Specific Equation (MSE)
- o The Generic MOS Equations (GME)

The MOS specific equation (MSE) examines variation in the attrition rate as a function of MOS assignment, AFQT group, and education. The attrition rates generated by this model will smooth historical differences while providing a coherent set of rates. This model is restricted to males.

The generic prediction equations will generate expected attrition rates based upon historical patterns. The equations will not be MOS specific, but will characterize the MOS through a set of descriptors. These descriptors will be the aptitude area composite used for assignment and the level of the aptitude area qualifying score. Separate equations are developed for males and females.

The reasons for the development of the second set of equations are twofold. First, individuals must be assigned to all MOS, not just the ones used in this research. Because some MOS have had too few accessions historically it becomes difficult to characterize rates on a limited number of observations. (This is the reason only 76 MOS were used in this analysis). Second, there are times when a new MOS is created, or an existing MOS is changed. In this case the use of historical data may be misleading or inappropriate. It would be desirable to project attrition based upon general characteristics of the MOS. Also the GME provides a vehicle for generating rates for the over 250 entry level MOS in the Army.

IV. MOS SPECIFIC EQUATION (MSE)

Structure of the Equation The MSE is a multiple regression model whose function is to derive a set of MOS specific attrition rates for the selected groups. The largest 76 MOS were examined, and rates were generated based upon MOS, Education and AFQT Group. Table 2 describes the variables. It should be noted that the AFQT groups used differ from those traditionally found in most Army research. Recent work by Moore et al (1983) have proposed alternate mission box categories to more accurately reflect aptitude differences within the accession population. Also, AFQT Groups IIIB and IV have been combined into one group because both groups exhibited similar attrition behavior.

Table 2: Definition of Categorical Variables Used in the MOS Specific Equation

AFQT Group

AFQT RANGE	AFQT CATEGORY
75-99	I-IIIA+ (constant)
50-74	I-IIIA- (M2)
11-49	IIIB-IV (M3)

Education

High School	Non-High School

MOS

See Table 1

The attrition rate is defined as one minus the rentention rate (equation 1), where the retention rate is the number of people reenlisting (REUP), plus the number of people reaching the end of their term of service (ETS), divided by the total number of accesions.

(1) ATTRITION = 1 - (ETS+REUP)/TOTAL ACCESSIONS

The structure of the MSE is provided by equation 2.

(2) $Y = a + b_1 G + b_2 M + b_3 E*G + b_4 E*M$

where:

G = AFQT Group (I-IIIA+, I-IIIA-,IIIB-IV)
E = Education (High School or Non-High School)
M = MOS 05B, 05C,.....,98C

The equation is composed of two categorical terms and two interaction terms. Education is used as an interaction term with both AFQT Groups and MOS.

<u>Results</u>. The MSE accounted for approximately 89% of the variation in the dependent variable ATTRITION, while the regression equation was significant at the .0001 level. The regression coefficients appear in Table 3. The standard error of estimate was .052. (AFQT I-IIIA+ is the omitted AFQT Group. MOS 98G is the omitted categorical variable for the MOS groups).

Variables in Table 3 can be identified as follows:

The first line in Table 3 is the constant (a). The default categories included in the constant are MOS 98G, non high school, and AFQT Category I-IIIA+.

M2 = I-IIIA-, M3 = IIIB-IV.

M05B through M98C are MOS specific coefficients.

I1 = the interaction term between AFQT I-IIIA- and Education (high school graduate). I2 = the interaction between AFQT IIIB-IV and Education (high school graduate).

I05B through I95B represent interaction between MOS and Education. In this case MOS 98C is the reference category.

TABLE 3

MOS SPECIFIC EQUATION RESULTS (MSE)

VARIABLE	B	t	Level of Significance
(CONSTANT)	0.29977	9.840	0.0000
AFQT EFFECTS			
M2	0.04284	3.450	0.0006
M3	0.07480	6.666	0.0000
MOS ASSIGNMENT EFFECTS			
M75C	-0.06098	-1.435	0.1522
M33S	-0.13912	-3.275	0.0012
M32D	0.00151	0.035	0.9717
M05K	-0.07000	-1.648	0.1004
M05G	-0.13423	-3.160	0.0017
M91Q	-0.05276	-1.242	0.2152
M71D	-0.00745	-0.157	0.8755
M91D	-0.02929	-0.737	0.4618
M91P	-0.11661	-2.933	0.0036

M91C	-0.03840	-0.966	0.3348
M71N	0.03317	0.834	0.4047
M71M	0.00919	0.231	0.8174
M55G	0.02410	0.606	0.5448
M05H	-0.07801	-1.962	0.0506
M52C	0.09673	2.192	0.0291
M61B	0.22544	4.594	0.0000
M17C	0.26541	6.494	0.0000
M41C	0.25044	4.083	0.0001
M63G	0.10964	2.485	0.0135
M76W	0.14959	3.390	0.0008
M76V	0.16869	3.823	0.0002
M16R	0.18161	4.443	0.0000
M57H	0.13831	2.819	0.0051
M11B	0.20233	4.950	0.0000
M16P	0.19265	4.714	0.0000
M16J	0.16949	4.147	0.0000
M16B	0.16306	3.990	0.0001
M15E	0.20440	5.001	0.0000
M05B	0.25659	6.278	0.0000
M31M	0.14059	3.440	0.0007
M12E	0.15885	3.887	0.0001
M12B	0.11939	2.921	0.0037
M05C	0.27159	6.645	0.0000
M36C	0.15258	3.733	0.0002
M12C	0.12840	3.141	0.0018
M15D	0.24239	5.931	0.0000
M13E	0.17997	4.403	0.0000
M13B	0.18197	4.452	0.0000
M36K	0.10753	2.631	0.0089
M52D	0.11199	2.740	0.0065
M45K	0.19371	4.740	0.0000
M63H	0.12605	3.084	0.0022
M62B	0.09040	2.212	0.0277
M67N	0.07293	1.784	0.0753

M64C	0.12677	3.102	0.0021
M67Y	0.00091	0.022	0.9823
M75B	0.11916	2.915	0.0038
M76Y	0.15286	3.740	0.0002
M82C	0.14948	3.657	0.0003
M95B	0.10404	2.546	0.0114
M94B	0.24163	5.912	0.0000
M91B	0.12705	3.109	0.0020
M31N	0.23743	5.381	0.0000
M17K	0.09115	2.066	0.0396
M67U	0.12804	2.902	0.0040
M43E	0.25068	5.681	0.0000
M31E	0.12799	2.901	0.0040
M54E	0.22103	5.009	0.0000
M27E	0.14727	3.338	0.0009
M75D	0.16259	3.685	0.0003
M67V	0.12093	2.741	0.0065
M76J	0.12511	2.835	0.0049
M76P	0.15618	3.540	0.0005
M62F	-0.03230	-0.658	0.5108
M71C	0.17988	3.671	0.0003
M91R	0.02544	0.415	0.6786
M51K	0.00044	0.007	0.9943
M51B	0.04210	0.687	0.4929
M62E	0.14396	2.347	0.0195
M75E	0.13826	2.254	0.0248
M73C	-0.16870	-2.740	0.0065
M55B	0.19306	4.375	0.0000

AFQT/EDUCATION INTERACTION

I1	-0.01873	-1.220	0.2233
I2	-0.03308	-2.397	0.0171

MOS/EDUCATION INTERACTION

I95B	-0.18728	-4.916	0.0000
I94B	-0.20194	-5.301	0.0000
I91E	-0.06383	-1.606	0.1093
I91B	-0.19740	-5.182	0.0000
I82C	-0.17461	-4.584	0.0000
I76Y	-0.13743	-3.608	0.0004
I76P	-0.16951	-4.078	0.0001
I91R	-0.11721	-1.911	0.0569
I76W	-0.15965	-3.590	0.0004
I76V	-0.22963	-5.163	0.0000
I63G	-0.21710	-4.881	0.0000
I62F	-0.03713	-0.752	0.4526
I51K	-0.04148	-0.674	0.5011
I17C	-0.27343	-6.690	0.0000
I61B	-0.22209	-3.406	0.0007
I41C	-0.37374	-4.992	0.0000
I76J	-0.20844	-5.015	0.0000
I75E	-0.16739	-2.813	0.0052
I75D	-0.19026	-4.578	0.0000
I75B	-0.17798	-4.672	0.0000
I73C	0.09314	1.559	0.1200
I71C	-0.11614	-2.487	0.0134
I67Y	-0.17150	-4.502	0.0000
I67V	-0.27352	-6.581	0.0000
I67U	-0.26670	-6.417	0.0000
I67N	-0.20398	-5.355	0.0000
I64C	-0.18274	-4.797	0.0000
I57H	-0.17313	-3.216	0.0014
I55B	-0.24304	-4.923	0.0000
I63H	-0.19332	-5.075	0.0000
I62E	-0.23563	-3.959	0.0001
I62B	-0.13405	-3.519	0.0005
I54E	-0.19607	-4.717	0.0000

I52D	-0.21107	-5.541	0.0000
I51B	-0.15316	-2.574	0.0105
I45K	-0.17109	-4.491	0.0000
I43E	-0.14677	-3.531	0.0005
I36K	-0.19659	-5.161	0.0000
I36C	-0.21502	-5.645	0.0000
I31N	-0.21126	-5.083	0.0000
I31M	-0.17061	-4.479	0.0000
I27E	-0.14866	-3.577	0.0004
I31E	-0.22194	-5.340	0.0000
I17K	-0.12331	-2.967	0.0032
I16R	-0.18238	-4.788	0.0000
I16P	-0.22604	-5.934	0.0000
I16J	-0.21173	-5.558	0.0000
I16B	-0.16963	-4.453	0.0000
I52C	-0.24669	-3.998	0.0001
I15E	-0.14206	-3.729	0.0002
I15D	-0.19649	-5.158	0.0000
I13E	-0.17296	-4.540	0.0000
I13B	-0.18740	-4.920	0.0000
I12E	-0.21966	-5.767	0.0000
I12C	-0.18449	-4.843	0.0000
I12B	-0.21740	-5.707	0.0000
I11B	-0.18359	-4.820	0.0000
I05C	-0.22888	-6.008	0.0000
I05B	-0.19198	-5.040	0.0000
I98C	-0.15222	-3.829	0.0002

Table 3 shows that all MOS/Education interaction terms (I05B....I98C), except MOS 73C, are negative. These negative coefficients indicate that high school graduates are less likely to leave prematurely regardless of MOS assignment. However, the size of these interaction terms exhibit variability. For example, line 2 of the education/MOS interaction terms show a coefficient of -.20194 (20 percent reduction) for MOS 94B, while line 3 shows this interaction to be -.06383 (6 percent reduction) for MOS 91E. It is important to note findings such as these because they demonstrate the differential effects of education by job assignment on the rate of attrition. Also, the higher the AFQT group the lower the attrition, since M2 (.04284) and M3 (.07480) are positive. Table 4 shows the range, mean, and standard deviation of both the MOS/Education interaction terms and the MOS terms.

Table 4

Descriptive Statistics for MSE Coefficients

	MAX	MEAN	MIN	STD DEV
MOS	.2716	.1070	-.1687	.1061
MOS/EDUC	.0931	-.1821	-.3737	.0645

The reason for the inclusion of the MOS/Education interaction is twofold. First, the addition of MOS/Education interaction terms decreased the standard error of the estimate by 4%. Second, the MSE with separate education and MOS terms explained 86% of the variation, while the interaction (unrestricted) equation explained

89%. This increase in explained variation and the concomitant decrease in standard error is significant when using a comparative F statistic and considering the number of linear restrictions imposed(see Appendix C). Table 3 also shows the t values of the coefficients, and their level of significance. While many of these coefficients are significant at the .05 level, it should be noted that this may be misleading. Since this is a categorical variable regression, the size and sign of the coefficients are determined by the reference group or omitted category. Suppose there exists some distribution P which is composed of all attrition rates. Since this is a categorical variable regression the size and sign of all regression coefficients depend upon which MOS is used as the reference category. If for example, the omitted MOS is picked from the area located near the mean, then there will be a fairly equal number of negative and positive coefficients and significance values. Also few coefficients will be large and therefore few t values will be significant. This is because the coefficient is in the numerator of the t equation (see equation 5). In contrast, if

(5) $t = bi/(\text{standard error of } bi)$

where:

bi = unstandardized coefficient

either extremal MOS is used as the reference category, then all coefficients and t values will be negative or positive (depending on which tail is used). Also in the extreme case only a few MOS will have small bi and t values since there is a low density in the tails of distribution P. Therefore it is important to examine the descriptive statistics of the coefficients (see Table 4). Two important results are the MOS specific and education coefficients. These coefficients (for non high school I-III A +) show considerable variability with mean results ranging from 16.1% to 56.5% for the same characteristic group of personnel. Table 5 shows the number of MOS associated with each interval. As can be seen there is a large amount of variation within one demographic group. Similarly, Table 6 illustrates the range in attrition reduction found across MOS due to education. The attrition reduction from the assignment of high school graduates can be over 30% in one MOS, and have virtually no impact in another MOS.

Table 5

Variability of Equation Coefficients by MOS

(for non-high school I-III A+)

Interval	Number of MOS
10-19.9%	5
20-29.9%	9
30-39.9%	13
40-49.9%	33
50% and above	12

mean attrition rate 40.0%

standard deviation 11.0%

Table 6

Reduction of Attrition for High School Graduates

Interval	Number of MOS
Increased attrition	1
reduction of 0-9.9%	3
reduction of 10-14.9%	8
reduction of 15-19.9%	25
reduction of 20-24.9%	23
reduction of 25-29.9%	3
reduction of over 30%	1
mean reduction	18.4%
standard deviation	5.9%

The MSE shows consistent behavior. First, high school graduates have lower attrition than non-high school graduates within categories of AFQT and MOS assignment. This relationship has been a long standing fact in the manpower planning of military personnel (Kissler 1980). Second, as AFQT Group increases, attrition decreases. (This relationship can be seen on Table 3). Blandin and Morris (1982) found similar AFQT Group findings in their research on non-high school Army enlistees. Although their work used the traditional AFQT categories, the overall effects of AFQT Group on first term attrition are in agreement with the findings presented here. And finally, MOS show differential attrition behavior within categories of AFQT Group and Education. Differential attrition, based upon job assignment, is an important finding in view of the allocation decisions made when an applicant signs a contract.

V. GENERIC MOS EQUATIONS (GME)

Generic MOS Equation (Males) The GME is a regression equation similar to the MSE, except that it is not MOS specific. This model uses the aptitude area composite and the required aptitude area score level as a generalized representation for MOS. The same data are used in deriving the regression coefficients. As stated previously, these equations provide predicted percentages of attrition where it does not exist historically or where cell size is too small.

The variables used in this model are described in Table 4. The form of the GME is shown in equation 3.

$$(3)\ Y = a + b_1 G + b_2 C + b_3 S + b_4 G{*}S + b_5 E{*}G + b_6 E{*}C + b_7 E{*}S$$

where:

G and E are described above

C = Aptitude area composite

S = Aptitude area score level

This model is composed of three categorical variables (E,G,C,), one continuous variable (S), and four interaction terms. It can be seen that the variable E (education) is used in interaction with all other variables and is therefore excluded from the regression equation itself. The coefficient b4 represents the interaction between AFQT group and the level of the aptitude area score used for assignment. AFQT I-IIIA+, education (non-high school) and the aptitude area ST (Skilled Technical) are the omitted categories.

Table 7

Categorical Variables Used in the Generic MOS Equation

AFQT Group

AFQT Range	AFQT Category Model
75-99	I-IIIA+
50-74	I-IIIA-
11-49	IIIB-IV

Education

High School	Non-High School

Aptitude Area Composite

(A6) CO-Combat	(A5) SC-Survellance
(A7) FA-Field Artillery	(A4) MM-Mech. Maintenance
(A2) EL-Electronics	(A3) CL-Clerical
(A8) OF-Operators/Food	(A1) GM-Gen. Maintenance
(A9) ST-Skilled Technical	

Aptitude Area Qualifying Score

80 = 0	105 = 6
85 = 1	110 = 7
90 = 2	115 = 8
95 = 3	120 = 9
100 = 4	

Results. The equation for males was able to explain approximately 74 percent of the variation in attrition and was significant at the .0001 level. The standard error of the estimate was .071, compared to .052 for the MSE. While the GME accounted for less variation then the MSE, it still has considerable value for providing an estimated or surrogate rate for a particular MOS. The regression equation coefficients are presented in Table 8.

The variables in Table 8 can be identified as follows:

M2 = I-IIIA-. M3 = IIIB-IV.

A1 through A8 are the aptitude area scores (see Table 7)

A9 (Skilled Technical) is the ommitted category.

CS is the aptitude area score level used for assignment.

AI1 through AI8 are the interactions between aptitude area score and education (high school graduate).

CE is the interaction between education (high school) and the level of the aptitude area score used for assignment.

C1 is the interaction between CS and AFQT Group I-IIIA-, while C2 is the interaction between CS anf AFQT IIIB-IV.

I1 is the interaction between Education (high school) and I-IIIA-, while I2 is the interaction between high school graduates and AFQT Group IIIB-IV.

Table 8

Generic MOS Equation Coefficients (Male)

VARIABLE	COEFFICIENT	t	Level of Significance
(CONSTANT)	0.34630	15.825	0.0000
M2	0.09613	3.646	0.0003
M3	0.11074	4.805	0.0000
CE	-0.03607	-7.076	0.0000
C1	-0.01150	-1.297	0.1954
C2	-0.00341	-0.434	0.6648
I1	-0.05663	-2.922	0.0037
I2	-0.07484	-4.459	0.0000
CS	0.01294	1.638	0.1021
A5	0.12800	5.662	0.0000
A2	0.04440	2.134	0.0334
A4	0.00046	0.025	0.9800
A3	0.03260	1.683	0.0930
A7	0.09578	2.521	0.0121
A6	0.06843	2.829	0.0049
A8	0.09779	5.450	0.0000
A1	0.04110	2.089	0.0372
AI2	-0.04175	-1.633	0.1033
AI3	-0.02110	-0.948	0.3436
AI8	-0.09566	-4.572	0.0000
AI7	-0.12098	-2.361	0.0187
AI6	-0.11642	-3.760	0.0002
AI1	-0.07727	-3.427	0.0007
AI5	-0.10588	-3.739	0.0002
AI4	-0.07618	-3.382	0.0008

In its simplest form the equation (Y = a) represents the expected attrition rate (.3463) of a non-high school AFQT I-IIIA+ male who is assigned to an MOS with an ST requirement of 80. No such MOS exist at this time having these requirements; this would be the expected attrition rate if such an MOS were created and non-high school males in AFQT category I-IIIA+ were assigned to it.

Table 9 shows the predicted attrition rates using the Male GME. These rates are for categories of AFQT, education and Aptitude Area when the score used for assignment is 90. Table 10 shows predicted rates for the same categories when the aptitude area score used for assignment is 100. Comparing the rates from these two tables shows that as aptitude area score requirements increase from 90 to 100, differences in attrition between high school graduates and non-graduates become greater. These tables highlight the differential attrition of accessions based on MOS difficulty. Also these results show the effect of the "type" of job assignment. For example, Mechanical Maintenance (MM) and Clerical (CL) have very different rates of attrition for all AFQT and education groups. MM has the lowest rates of attrition, while CL has the highest. Another interesting point is that AFQT differences are more pronounced in the non-high school categories, although there are still sizable differences in the high school graduate groups.

Table 9

GME Predicted Rates with Score Level 90

(Males)

	High School AFQT Group			Non-High School AFQT Group		
	I-IIIA+	I-IIIA-	IIIB-IV	I-IIIA+	I-IIIA-	IIIB-IV
GM	.264	.292	.296	.413	.498	.520
EL	.303	.331	.335	.416	.501	.523
CL	.312	.340	.344	.405	.490	.512
MM	.224	.252	.256	.372	.457	.479
SC	.322	.350	.354	.500	.585	.607
CO	.252	.280	.284	.440	.525	.547
FA	.275	.303	.307	.468	.553	.575
OF	.302	.330	.334	.470	.555	.577
ST	.300	.328	.332	.372	.457	.479

Table 10

GME Predicted Rates with Score Level 100

(Males)

	High School AFQT Group			Non-High School AFQT Group		
	I-IIIA+	I-IIIA-	IIIB-IV	I-IIIA+	I-IIIA-	IIIB-IV
GM	.218	.246	.250	.439	.524	.546
EL	.257	.285	.289	.442	.527	.549
CL	.266	.294	.298	.431	.516	.538
MM	.178	.206	.210	.398	.483	.505
SC	.276	.304	.308	.526	.611	.633
CO	.206	.234	.238	.466	.551	.573
FA	.229	.257	.261	.494	.579	.601
OF	.256	.284	.288	.496	.581	.603
ST	.254	.282	.286	.398	.483	.505

Generic MOS Equation (Female)

The construction of the female GME is similar to the male counterpart using AFQT Group and aptitude area as the independent variables (equation 4). Education is not used as an independent variable since few female accessions are non-high school graduates. Also, only two AFQT Groups (I-IIIA and IIIB-IV) are used because of the limited observations available for females. Since the aptitude area score level did not seem to have an appreciable effect on explaining variation in attrition, it was dropped from the female equation.

$$(4)\ Y = a + b_1 G + b_2 C$$

where:

G = AFQT Group

C = Aptitude Area Score used for assignment

The above model is composed of two categorical variables. I-IIIA is the omitted AFQT Group, and ST is the omitted aptitude area score. Also, the aptitude area score FA (Field Artillery) and CO (Combat Arms) are not used since females are not assigned to combat MOS.

Results. As expected the female GPM results are not as profound as the male GME. However, aptitude area score used for assignment did show interesting differences with respect to variability in predicting attrition rates. The female GPM explained approximately 32 percent of the variation in attrition. Compared to the strengths of the other two models, this model is far less powerful. This is to be expected, since there was no variability due to education. However, it is still capable of providing differences which reflect real trade-offs in differential assignment to MOS. Table 11 shows the regression equation coefficients and their significance. The entire equation was significant at the .0001 level while the standard error of the estimate was .072.

Table 11

Generic MOS Equation Coefficients (Female)

VARIABLE	COEFFICIENT	t	Level of Significance
(CONSTANT)	0.38533	22.235	0.0000
M2	0.01137	0.686	0.4947
A8	0.11884	3.519	0.0007
A5	0.17717	2.378	0.0199
A4	0.13519	4.677	0.0000
A2	0.09866	3.394	0.0011
A1	0.10265	3.677	0.0004
A3	0.05707	2.725	0.0080

Overall, the male GME is a superior equation to the female GME in terms of explained variation. There are reasons for this: First, the female data base used in the regression is considerably smaller than the data used for males. Also, policy effects, in relation to first term attrition, may play a greater role in female rates than in the attrition rate of males. And finally, there is less variability in the kinds of jobs to which females are assigned. Even though the R-square was lower than the male equation, the standard error was almost the same.

VI. DISCUSSION OF RESULTS

Table 12 shows the summary statistics for the male rates generated by the MSE and the male GME. Overall, .6462 is the highest predicted rate of attrition (MOS 05C, for a non-high school graduate of AFQT group IIIB-IV). The lowest predicted rate for males is .1292 for a AFQT I-IIIA+ high school graduate assigned to MOS 67Y. When comparing the mean, the largest differences are in the high school and non-high school groups, .2811 and .4792, respectively. Within categories of AFQT there are sizable differences when comparing group means. Appendix A lists all rates for males. (The symbol * denotes when the GME was used).

Table 12

Range of Male Rates

	Max	Mean	Min	Std dev	N
High School	.4454	.2811	.1292	.0606	228
Non-High School	.6462	.4792	.1739	.0677	228
AFQT I-IIIA+	.5714	.3460	.1292	.1009	152
AFQT I-IIIA-	.6142	.3842	.1533	.1182	152
AFQT IIIB-IV	.6462	.4102	.1709	.1254	152
All Categories	.6462	.3802	.1292	.1181	456

Table 13 shows the summary statistics for the female rates. As can be seen there is less variation within the predicted female rates. This is not unexpected since the female GME had a low R-square when compared to the male equations. Female rates range from .3853 to .5739, with an average rate of .4727. This average rate is considerably higher than that for males (.3802). The range of rates for females is still sizable, showing a reasonable amount of variation.

Table 13

Range of Female Rates

	Max	Mean	Min	Std dev	N
AFQT I-IIIA	.5625	.4669	.3853	.0522	68
AFQT IIIB-IV	.5739	.4783	.3967	.0522	68
All Categories	.5739	.4727	.3853	.0542	136

The predicted rates of attrition for females is presented in Appendix B.

VII. CONCLUSIONS

The MOS specific and generic equations provide for a way of estimating the first-term attrition of different groups of enlisted personnel within the U.S. Army. These estimates of attrition rates can be used as cost measures when allocating personnel in the future. At this point it would be difficult to determine what savings (with respect to lower attrition), if any, could be had with alternative allocation policies and systems. However, the importance of these findings is that there exists the potential for reducing the overall rate of first term attrition. The results have shown that:

- o Historical attrition can be explained by organizational factors (MOS, Aptitude Area) and individual factors (Sex, AFQT, Education)
- o There exists interaction between organizational factors and individual factors. (The significant inclusion of the MOS/Education interaction terms show this.)
- o Variation in the range of attrition is sizable, ranging from about 12 to 64 percent, ~~to~~ present many significant tradeoffs; indeed 67 of the 76 MOS used in this analysis (or 88 percent) show more than a 20 percent range in attrition within various demographic groups (Education, Sex, AFQT).

The most important finding is that attrition rates can be projected using data that exists prior to MOS assignment. The implication of this is that changes in allocation policies or systems can increase first term retention. While additional screening mechanisms, recruiting effort or other policies can improve retention, they often involve considerable direct costs. However, by understanding real trade offs in allocation retention can be increased with virtually no additional cost.

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APPENDIX A

PROJECTED ATTRITION RATES BY CATEGORY

Education	AFQT Category	MOS	Attrition Rate
NHS	I-IIIA-	05B SC 90	0.599200
NHS	III-IV	05B SC 90	0.631200
HS	I-IIIA+	05B SC 90	0.364400
HS	I-IIIA-	05B SC 90	0.388500
HS	III-IV	05B SC 90	0.406100
NHS	I-IIIA+	05C SC 95	0.571400
NHS	I-IIIA-	05C SC 95	0.614200
NHS	III-IV	05C SC 95	0.646200
HS	I-IIIA+	05C SC 95	0.342500
HS	I-IIIA-	05C SC 95	0.366600
HS	III-IV	05C SC 95	0.384200
NHS	I-IIIA+	05G SC 95	0.513120 *
NHS	I-IIIA-	05G SC 95	0.574750 *
NHS	III-IV	05G SC 95	0.613630 *
HS	I-IIIA+	05G SC 95	0.165500
HS	I-IIIA-	05G SC 95	0.189700
HS	III-IV	05G SC 95	0.207300
NHS	I-IIIA+	05H ST 95	0.385120 *
NHS	I-IIIA-	05H ST 95	0.446750 *
NHS	III-IV	05H ST 95	0.485630 *
HS	I-IIIA+	05H ST 95	0.221800
HS	I-IIIA-	05H ST 95	0.245900
HS	III-IV	05H ST 95	0.263500
NHS	I-IIIA+	05K ST 95	0.385120 *
NHS	I-IIIA-	05K ST 95	0.446750 *
NHS	III-IV	05K ST 95	0.485630 *
HS	I-IIIA+	05K ST 95	0.229800
HS	I-IIIA-	05K ST 95	0.253900
HS	III-IV	05K ST 95	0.271500

NHS	I-IIIA+	11X CO	85	0.502100
NHS	I-IIIA-	11X CO	85	0.544900
NHS	III-IV	11X CO	85	0.576900
HS	I-IIIA+	11X CO	85	0.318500
HS	I-IIIA-	11X CO	85	0.342600
HS	III-IV	11X CO	85	0.360200
NHS	I-IIIA+	12B CO	85	0.419200
NHS	I-IIIA-	12B CO	85	0.462000
NHS	III-IV	12B CO	85	0.494000
HS	I-IIIA+	12B CO	85	0.201800
HS	I-IIIA-	12B CO	85	0.225900
HS	III-IV	12B CO	85	0.243500
NHS	I-IIIA+	12C MM	85	0.428200
NHS	I-IIIA-	12C MM	85	0.471000
NHS	III-IV	12C MM	85	0.503000
HS	I-IIIA+	12C MM	85	0.243700
HS	I-IIIA-	12C MM	85	0.267800
HS	III-IV	12C MM	85	0.285400
NHS	I-IIIA+	12E CO	95	0.458600
NHS	I-IIIA-	12E CO	95	0.501500
NHS	III-IV	12E CO	95	0.533400
HS	I-IIIA+	12E CO	95	0.239000
HS	I-IIIA-	12E CO	95	0.263100
HS	III-IV	12E CO	95	0.280700
NHS	I-IIIA+	13B FA	85	0.481700
NHS	I-IIIA-	13B FA	85	0.524600
NHS	III-IV	13B FA	85	0.556500
HS	I-IIIA+	13B FA	85	0.294300
HS	I-IIIA-	13B FA	85	0.318400
HS	III-IV	13B FA	85	0.336000
NHS	I-IIIA+	13E ST	95	0.479700 *
NHS	I-IIIA-	13E ST	95	0.522600 *
NHS	III-IV	13E ST	95	0.554500
HS	I-IIIA+	13E ST	95	0.306800
HS	I-IIIA-	13E ST	95	0.330900
HS	III-IV	13E ST	95	0.348500
NHS	I-IIIA+	15D OF	95	0.542200
NHS	I-IIIA-	15D OF	95	0.585000
NHS	III-IV	15D OF	95	0.617000
HS	I-IIIA+	15D OF	95	0.345700
HS	I-IIIA-	15D OF	95	0.369800
HS	III-IV	15D OF	95	0.387400

NHS	I-IIIA+	15E OF	95	0.504200
NHS	I-IIIA-	15E OF	95	0.547000
NHS	III-IV	15E OF	95	0.579000
HS	I-IIIA+	15E OF	95	0.362100
HS	I-IIIA-	15E OF	95	0.386200
HS	III-IV	15E OF	95	0.403800
NHS	I-IIIA+	16B OF	85	0.462800
NHS	I-IIIA-	16B OF	85	0.505700
NHS	III-IV	16B OF	85	0.537600
HS	I-IIIA+	16B OF	85	0.293200
HS	I-IIIA-	16B OF	85	0.317300
HS	III-IV	16B OF	85	0.334900
NHS	I-IIIA+	16J OF	95	0.469300
NHS	I-IIIA-	16J OF	95	0.512100
NHS	III-IV	16J OF	95	0.544100
HS	I-IIIA+	16J OF	95	0.257500
HS	I-IIIA-	16J OF	95	0.281600
HS	III-IV	16J OF	95	0.299300
NHS	I-IIIA+	16P OF	85	0.492400
NHS	I-IIIA-	16P OF	85	0.535300
NHS	III-IV	16P OF	85	0.567200
HS	I-IIIA+	16P OF	85	0.266400
HS	I-IIIA-	16P OF	85	0.290500
HS	III-IV	16P OF	85	0.308100
NHS	I-IIIA+	16R SC	100	0.481400 *
NHS	I-IIIA-	16R SC	100	0.524200 *
NHS	III-IV	16R SC	100	0.556200
HS	I-IIIA+	16R SC	100	0.299000
HS	I-IIIA-	16R SC	100	0.323100
HS	III-IV	16R SC	100	0.340700
NHS	I-IIIA+	17C SC	95	0.565200
NHS	I-IIIA-	17C SC	95	0.608000
NHS	III-IV	17C SC	95	0.640000
HS	I-IIIA+	17C SC	95	0.291700
HS	I-IIIA-	17C SC	95	0.315900
HS	III-IV	17C SC	95	0.333500
NHS	I-IIIA+	17K SC	95	0.513120 *
NHS	I-IIIA-	17K SC	95	0.433800
NHS	III-IV	17K SC	95	0.465700
HS	I-IIIA+	17K SC	95	0.267600
HS	I-IIIA-	17K SC	95	0.291700
HS	III-IV	17K SC	95	0.309300

NHS	I-IIIA+	27E EL 95	0.429520 *
NHS	I-IIIA-	27E EL 95	0.489900
NHS	III-IV	27E EL 95	0.521800
HS	I-IIIA+	27E EL 95	0.298400
HS	I-IIIA-	27E EL 95	0.322500
HS	III-IV	27E EL 95	0.340100
NHS	I-IIIA+	31E EL 110	0.468340 *
NHS	I-IIIA-	31E EL 110	0.470600
NHS	III-IV	31E EL 110	0.502500
HS	I-IIIA+	31E EL 110	0.205800
HS	I-IIIA-	31E EL 110	0.229900
HS	III-IV	31E EL 110	0.247500
NHS	I-IIIA+	31M EL 95	0.440400
NHS	I-IIIA-	31M EL 95	0.483200
NHS	III-IV	31M EL 95	0.515200
HS	I-IIIA+	31M EL 95	0.269700
HS	I-IIIA-	31M EL 95	0.293900
HS	III-IV	31M EL 95	0.311500
NHS	I-IIIA+	31N EL 95	0.429520 *
NHS	I-IIIA-	31N EL 95	0.580000
NHS	III-IV	31N EL 95	0.612000
HS	I-IIIA+	31N EL 95	0.325900
HS	I-IIIA-	31N EL 95	0.350100
HS	III-IV	31N EL 95	0.367700
NHS	I-IIIA+	32D EL 95	0.429520 *
NHS	I-IIIA-	32D EL 95	0.491150 *
NHS	III-IV	32D EL 95	0.530030 *
HS	I-IIIA+	32D EL 95	0.301300
HS	I-IIIA-	32D EL 95	0.325400
HS	III-IV	32D EL 95	0.343000
NHS	I-IIIA+	33S MM 95	0.385590 *
NHS	I-IIIA-	33S MM 95	0.447220 *
NHS	III-IV	33S MM 95	0.486100 *
HS	I-IIIA+	33S MM 95	0.160600
HS	I-IIIA-	33S MM 95	0.184300
HS	III-IV	33S MM 95	0.202400
NHS	I-IIIA+	36C EL 90	0.452300
NHS	I-IIIA-	36C EL 90	0.495200
NHS	III-IV	36C EL 90	0.527100
HS	I-IIIA+	36C EL 90	0.237300
HS	I-IIIA-	36C EL 90	0.261400
HS	III-IV	36C EL 90	0.279000

NHS	I-IIIA+	36K EL	90	0.407300
NHS	I-IIIA-	36K EL	90	0.450100
NHS	III-IV	36K EL	90	0.482100
HS	I-IIIA+	36K EL	90	0.210700
HS	I-IIIA-	36K EL	90	0.234800
HS	III-IV	36K EL	90	0.252400
NHS	I-IIIA+	41C GM	90	0.413280 *
NHS	I-IIIA-	41C GM	90	0.486410 *
NHS	III-IV	41C GM	90	0.625000
HS	I-IIIA+	41C GM	90	0.263870 *
HS	I-IIIA-	41C GM	90	0.297500 *
HS	III-IV	41C GM	90	0.218200
NHS	I-IIIA+	43E GM	85	0.400340 *
NHS	I-IIIA-	43E GM	85	0.593300
NHS	III-IV	43E GM	85	0.625200
HS	I-IIIA+	43E GM	85	0.403700
HS	I-IIIA-	43E GM	85	0.427800
HS	III-IV	43E GM	85	0.445400
NHS	I-IIIA+	45K GM	95	0.493500
NHS	I-IIIA-	45K GM	95	0.536300
NHS	III-IV	45K GM	95	0.568300
HS	I-IIIA+	45K GM	95	0.322400
HS	I-IIIA-	45K GM	95	0.346500
HS	III-IV	45K GM	95	0.364100
NHS	I-IIIA+	51B GM	85	0.400340 *
NHS	I-IIIA-	51B GM	85	0.484970 *
NHS	III-IV	51B GM	85	0.416700
HS	I-IIIA+	51B GM	85	0.188700
HS	I-IIIA-	51B GM	85	0.212800
HS	III-IV	51B GM	85	0.230400
NHS	I-IIIA+	51K GM	85	0.400340 *
NHS	I-IIIA-	51K GM	85	0.484970 *
NHS	III-IV	51K GM	85	0.375000
HS	I-IIIA+	51K GM	85	0.287000 *
HS	I-IIIA-	51K GM	85	0.282800
HS	III-IV	51K GM	85	0.300400
NHS	I-IIIA+	52C GM	95	0.426220 *
NHS	I-IIIA-	52C GM	95	0.439300
NHS	III-IV	52C GM	95	0.471300
HS	I-IIIA+	52C GM	95	0.240740 *
HS	I-IIIA-	52C GM	95	0.173900
HS	III-IV	52C GM	95	0.305350 *

NHS	I-IIIA+	52D GM	95	0.411800	
NHS	I-IIIA-	52D GM	95	0.454600	
NHS	III-IV	52D GM	95	0.486600	
HS	I-IIIA+	52D GM	95	0.200700	
HS	I-IIIA-	52D GM	95	0.224800	
HS	III-IV	52D GM	95	0.242400	
NHS	I-IIIA+	54E ST	90	0.372190	*
NHS	I-IIIA-	54E ST	90	0.563600	
NHS	III-IV	54E ST	90	0.595600	
HS	I-IIIA+	54E ST	90	0.324700	
HS	I-IIIA-	54E ST	90	0.348800	
HS	III-IV	54E ST	90	0.366400	
NHS	I-IIIA+	55B GM	85	0.400340	*
NHS	I-IIIA-	55B GM	85	0.535700	
NHS	III-IV	55B GM	85	0.567600	
HS	I-IIIA+	55B GM	85	0.287000	*
HS	I-IIIA-	55B GM	85	0.332130	*
HS	III-IV	55B GM	85	0.291500	
NHS	I-IIIA+	55G GM	95	0.426220	*
NHS	I-IIIA-	55G GM	95	0.487850	*
NHS	III-IV	55G GM	95	0.526730	*
HS	I-IIIA+	55G GM	95	0.323900	
HS	I-IIIA-	55G GM	95	0.348000	
HS	III-IV	55G GM	95	0.365600	
NHS	I-IIIA+	57H GM	85	0.400340	*
NHS	I-IIIA-	57H GM	85	0.484970	*
NHS	III-IV	57H GM	85	0.512900	
HS	I-IIIA+	57H GM	85	0.287000	*
HS	I-IIIA-	57H GM	85	0.332130	*
HS	III-IV	57H GM	85	0.306700	
NHS	I-IIIA+	61B MM	95	0.385590	*
NHS	I-IIIA-	61B MM	95	0.447220	*
NHS	III-IV	61B MM	95	0.600000	
HS	I-IIIA+	61B MM	95	0.201200	*
HS	I-IIIA-	61B MM	95	0.223330	*
HS	III-IV	61B MM	95	0.344800	
NHS	I-IIIA+	62B MM	85	0.390200	
NHS	I-IIIA-	62B MM	85	0.433000	
NHS	III-IV	62B MM	85	0.465000	
HS	I-IIIA+	62B MM	85	0.256100	
HS	I-IIIA-	62B MM	85	0.290200	
HS	III-IV	62B MM	85	0.297800	

NHS	I-IIIA+	62E GM 85	0.400340 *
NHS	I-IIIA-	62E GM 85	0.484970 *
NHS	III-IV	62E GM 85	0.518500
HS	I-IIIA+	62E GM 85	0.208100
HS	I-IIIA-	62E GM 85	0.232200
HS	III-IV	62E GM 85	0.249800
NHS	I-IIIA+	62F GM 85	0.400340 *
NHS	I-IIIA-	62F GM 85	0.484970 *
NHS	III-IV	62F GM 85	0.342300
HS	I-IIIA+	62F GM 85	0.287000 *
HS	I-IIIA-	62F GM 85	0.254400
HS	III-IV	62F GM 85	0.272100
NHS	I-IIIA+	63G MM 100	0.398530 *
NHS	I-IIIA-	63G MM 100	0.452300
NHS	III-IV	63G MM 100	0.484200
HS	I-IIIA+	63G MM 100	0.178070 *
HS	I-IIIA-	63G MM 100	0.216400
HS	III-IV	63G MM 100	0.234000
NHS	I-IIIA+	63H MM 85	0.425800
NHS	I-IIIA-	63H MM 85	0.468700
NHS	III-IV	63H MM 85	0.500600
HS	I-IIIA+	63H MM 85	0.232500
HS	I-IIIA-	63H MM 85	0.256600
HS	III-IV	63H MM 85	0.274200
NHS	I-IIIA+	64C OF 85	0.426500
NHS	I-IIIA-	64C OF 85	0.469400
NHS	III-IV	64C OF 85	0.501300
HS	I-IIIA+	64C OF 85	0.243800
HS	I-IIIA-	64C OF 85	0.267900
HS	III-IV	64C OF 85	0.285500
NHS	I-IIIA+	67N MM 100	0.372700
NHS	I-IIIA-	67N MM 100	0.415500
NHS	III-IV	67N MM 100	0.447500
HS	I-IIIA+	67N MM 100	0.168700
HS	I-IIIA-	67N MM 100	0.192900
HS	III-IV	67N MM 100	0.210400
NHS	I-IIIA+	67U MM 100	0.398530 *
NHS	I-IIIA-	67U MM 100	0.470700
NHS	III-IV	67U MM 100	0.502600
HS	I-IIIA+	67U MM 100	0.161100
HS	I-IIIA-	67U MM 100	0.185200
HS	III-IV	67U MM 100	0.202800

NHS	I-IIIA+	67V MM 100	0.398530 *
NHS	I-IIIA-	67V MM 100	0.463500
NHS	III-IV	67V MM 100	0.495500
HS	I-IIIA+	67V MM 100	0.147200
HS	I-IIIA-	67V MM 100	0.171300
HS	III-IV	67V MM 100	0.189900
NHS	I-IIIA+	67Y MM 100	0.300700
NHS	I-IIIA-	67Y MM 100	0.343500
NHS	III-IV	67Y MM 100	0.375500
HS	I-IIIA+	67Y MM 100	0.129200
HS	I-IIIA-	67Y MM 100	0.153300
HS	III-IV	67Y MM 100	0.170900
NHS	I-IIIA+	71C CL 95	0.417720 *
NHS	I-IIIA-	71C CL 95	0.522500
NHS	III-IV	71C CL 95	0.554400
HS	I-IIIA+	71C CL 95	0.363500
HS	I-IIIA-	71C CL 95	0.387600
HS	III-IV	71C CL 95	0.405200
NHS	I-IIIA+	71D CL 110	0.456540 *
NHS	I-IIIA-	71D CL 110	0.483670 *
NHS	III-IV	71D CL 110	0.546820 *
HS	I-IIIA+	71D CL 110	0.292300
HS	I-IIIA-	71D CL 110	0.316400
HS	III-IV	71D CL 110	0.273400
NHS	I-IIIA+	71L CL 95	0.417720 *
NHS	I-IIIA-	71L CL 95	0.479350 *
NHS	III-IV	71L CL 95	0.518230
HS	I-IIIA+	71L CL 95	0.288410 *
HS	I-IIIA-	71L CL 95	0.310540 *
HS	III-IV	71L CL 95	0.341500
NHS	I-IIIA+	71M CL 95	0.417720 *
NHS	I-IIIA-	71M CL 95	0.479350 *
NHS	III-IV	71M CL 95	0.518230 *
HS	I-IIIA+	71M CL 95	0.309000
HS	I-IIIA-	71M CL 95	0.333100
HS	III-IV	71M CL 95	0.350700
NHS	I-IIIA+	71N CL 95	0.417720 *
NHS	I-IIIA-	71N CL 95	0.479350 *
NHS	III-IV	71N CL 95	0.518230 *
HS	I-IIIA+	71N CL 95	0.332900
HS	I-IIIA-	71N CL 95	0.357000
HS	III-IV	71N CL 95	0.374700

NHS	I-IIIA+	73C CL 95	0.417720 *
NHS	I-IIIA-	73C CL 95	0.173900 *
NHS	III-IV	73C CL 95	0.518230 *
HS	I-IIIA+	73C CL 95	0.224200
HS	I-IIIA-	73C CL 95	0.248300
HS	III-IV	73C CL 95	0.265900
NHS	I-IIIA+	75B CL 95	0.418900
NHS	I-IIIA-	75B CL 95	0.461800
NHS	III-IV	75B CL 95	0.493700
HS	I-IIIA+	75B CL 95	0.240900
HS	I-IIIA-	75B CL 95	0.265100
HS	III-IV	75B CL 95	0.282700
NHS	I-IIIA+	75C CL 95	0.417720 *
NHS	I-IIIA-	75C CL 95	0.479350
NHS	III-IV	75C CL 95	0.518230
HS	I-IIIA+	75C CL 95	0.238800
HS	I-IIIA-	75C CL 95	0.262900
HS	III-IV	75C CL 95	0.280500
NHS	I-IIIA+	75D CL 95	0.417720 *
NHS	I-IIIA-	75D CL 95	0.505200
NHS	III-IV	75D CL 95	0.537200
HS	I-IIIA+	75D CL 95	0.272100
HS	I-IIIA-	75D CL 95	0.296200
HS	III-IV	75D CL 95	0.313800
NHS	I-IIIA+	75E CL 95	0.417720 *
NHS	I-IIIA-	75E CL 95	0.479350 *
NHS	III-IV	75E CL 95	0.512800
HS	I-IIIA+	75E CL 95	0.270600
HS	I-IIIA-	75E CL 95	0.294700
HS	III-IV	75E CL 95	0.312400
NHS	I-IIIA+	76J CL 95	0.417720 *
NHS	I-IIIA-	76J CL 95	0.467700
NHS	III-IV	76J CL 95	0.499700
HS	I-IIIA+	76J CL 95	0.216400
HS	I-IIIA-	76J CL 95	0.240600
HS	III-IV	76J CL 95	0.258200
NHS	I-IIIA+	76P CL 90	0.404780 *
NHS	I-IIIA-	76P CL 90	0.498800
NHS	III-IV	76P CL 90	0.530700
HS	I-IIIA+	76P CL 90	0.286400
HS	I-IIIA-	76P CL 90	0.310600
HS	III-IV	76P CL 90	0.328200

NHS	I-IIIA+	76V CL 90	0.404780 *
NHS	I-IIIA-	76V CL 90	0.511300
NHS	III-IV	76V CL 90	0.543300
HS	I-IIIA+	76V CL 90	0.311540 *
HS	I-IIIA-	76V CL 90	0.262900
HS	III-IV	76V CL 90	0.280500
NHS	I-IIIA+	76W CL 90	0.404780 *
NHS	I-IIIA-	76W CL 90	0.492200
NHS	III-IV	76W CL 90	0.524200
HS	I-IIIA+	76W CL 90	0.311540 *
HS	I-IIIA-	76W CL 90	0.313800
HS	III-IV	76W CL 90	0.331400
NHS	I-IIIA+	76Y CL 95	0.452600
NHS	I-IIIA-	76Y CL 95	0.495500
NHS	III-IV	76Y CL 95	0.527400
HS	I-IIIA+	76Y CL 95	0.315200
HS	I-IIIA-	76Y CL 95	0.339300
HS	III-IV	76Y CL 95	0.356900
NHS	I-IIIA+	82C ST 95	0.449300
NHS	I-IIIA-	82C ST 95	0.492100
NHS	III-IV	82C ST 95	0.524000
HS	I-IIIA+	82C ST 95	0.274600
HS	I-IIIA-	82C ST 95	0.298700
HS	III-IV	82C ST 95	0.316400
NHS	I-IIIA+	91B ST 95	0.426900
NHS	I-IIIA-	91B ST 95	0.469700
NHS	III-IV	91B ST 95	0.501600
HS	I-IIIA+	91B ST 95	0.229400
HS	I-IIIA-	91B ST 95	0.253500
HS	III-IV	91B ST 95	0.271100
NHS	I-IIIA+	91C ST 95	0.385120 *
NHS	I-IIIA-	91C ST 95	0.446750 *
NHS	III-IV	91C ST 95	0.485630 *
HS	I-IIIA+	91C ST 95	0.261400
HS	I-IIIA-	91C ST 95	0.285500
HS	III-IV	91C ST 95	0.303100
NHS	I-IIIA+	91D ST 95	0.385120 *
NHS	I-IIIA-	91D ST 95	0.446750 *
NHS	III-IV	91D ST 95	0.485630 *
HS	I-IIIA+	91D ST 95	0.270500
HS	I-IIIA-	91D ST 95	0.294600
HS	III-IV	91D ST 95	0.312200

NHS	I-IIIA+	91E ST 95	0.385120 *
NHS	I-IIIA-	91E ST 95	0.446750 *
NHS	III-IV	91E ST 95	0.485630 *
HS	I-IIIA+	91E ST 95	0.235900
HS	I-IIIA-	91E ST 95	0.260000
HS	III-IV	91E ST 95	0.277700
NHS	I-IIIA+	91P ST 100	0.398060 *
NHS	I-IIIA-	91P ST 100	0.448190 *
NHS	III-IV	91P ST 100	0.495160 *
HS	I-IIIA+	91P ST 100	0.183200
HS	I-IIIA-	91P ST 100	0.207300
HS	III-IV	91P ST 100	0.224900
NHS	I-IIIA+	91Q ST 95	0.385120 *
NHS	I-IIIA-	91Q ST 95	0.446750 *
NHS	III-IV	91Q ST 95	0.485630 *
HS	I-IIIA+	91Q ST 95	0.247000
HS	I-IIIA-	91Q ST 95	0.271100
HS	III-IV	91Q ST 95	0.288700
NHS	I-IIIA+	91R ST 100	0.398060 *
NHS	I-IIIA-	91R ST 100	0.448190 *
NHS	III-IV	91R ST 100	0.400000
HS	I-IIIA+	91R ST 100	0.208000
HS	I-IIIA-	91R ST 100	0.232100
HS	III-IV	91R ST 100	0.249700
NHS	I-IIIA+	94B OF 85	0.541400
NHS	I-IIIA-	94B OF 85	0.584200
NHS	III-IV	94B OF 85	0.616200
HS	I-IIIA+	94B OF 85	0.339400
HS	I-IIIA-	94B OF 85	0.363600
HS	III-IV	94B OF 85	0.381200
NHS	I-IIIA+	95B ST 100	0.403800
NHS	I-IIIA-	95B ST 100	0.446600
NHS	III-IV	95B ST 100	0.478600
HS	I-IIIA+	95B ST 100	0.216500
HS	I-IIIA-	95B ST 100	0.240600
HS	III-IV	95B ST 100	0.258300
NHS	I-IIIA+	98C ST 105	0.411000 *
NHS	I-IIIA-	98C ST 105	0.449630 *
NHS	III-IV	98C ST 105	0.504690 *
HS	I-IIIA+	98C ST 105	0.147600
HS	I-IIIA-	98C ST 105	0.171700
HS	III-IV	98C ST 105	0.189300
NHS	I-IIIA+	98G ST 95	0.395120 *
NHS	I-IIIA-	98G ST 95	0.446750 *
NHS	III-IV	98G ST 95	0.485630 *
HS	I-IIIA+	98G ST 95	0.299300
HS	I-IIIA-	98G ST 95	0.323900
HS	III-IV	98G ST 95	0.341520 *

APPENDIX B

FEMALE ATTRITION RATES BY MOS

AFQT GROUP I-IIIA

05B	0.5625
05C	0.5625
05G	0.5625
05H	0.3853
05K	0.3853
12C	0.5205
15D	0.5042
15E	0.5042
16B	0.5042
16J	0.5042
17C	0.5625
27E	0.4840
31E	0.4840
31M	0.4840
31N	0.4840
32D	0.4840
33S	0.5205
36C	0.4840
36K	0.4840
41C	0.4880
43E	0.4880
45K	0.4880
51B	0.4880
51K	0.4880
52C	0.4880
52D	0.4880
54E	0.3853
55B	0.4880
55G	0.4880
57H	0.4880
61B	0.5205
62B	0.5205
62E	0.4880
62F	0.4880
63G	0.5205
63H	0.5205
64C	0.5042
67N	0.5205
67U	0.5205
67V	0.5205
67Y	0.5205
71C	0.4424
71D	0.4424
71L	0.4424
71M	0.4424

71N	0.4424
73C	0.4424
75B	0.4424
75C	0.4424
75D	0.4424
75E	0.4424
76J	0.4424
76P	0.4424
76V	0.4424
76W	0.4424
76Y	0.4424
82C	0.3853
91B	0.3853
91C	0.3853
91D	0.3853
91E	0.3853
91P	0.3853
91Q	0.3853
91R	0.3853
94B	0.5042
95B	0.3853
98C	0.3853
98G	0.3853

AFQT GROUP IIIB-IV

05B	0.5739
05C	0.5739
05G	0.5739
05H	0.3967
05K	0.3967
12C	0.5319
15D	0.5156
15E	0.5156
16B	0.5156
16J	0.5156
17C	0.5739
27E	0.4954
31E	0.4954
31M	0.4954
31N	0.4954
32D	0.4954
33S	0.5319
36C	0.4954
36K	0.4954
41C	0.4994
43E	0.4994
45K	0.4994
51B	0.4994

51K	0.4994
52C	0.4994
52D	0.4994
54E	0.3967
55B	0.4994
55G	0.4994
57H	0.4994
61B	0.5319
62B	0.5319
62E	0.4994
62F	0.4994
63G	0.5319
63H	0.5319
64C	0.5156
67N	0.5319
67U	0.5319
67V	0.5319
67Y	0.5319
71C	0.4538
71D	0.4538
71L	0.4538
71M	0.4538
71N	0.4538
73C	0.4538
75B	0.4538
75C	0.4538
75D	0.4538
75E	0.4538
76J	0.4538
76P	0.4538
76V	0.4538
76W	0.4538
76Y	0.4538
82C	0.3967
91B	0.3967
91C	0.3967
91D	0.3967
91E	0.3967
91P	0.3967
91Q	0.3967
91R	0.3967
94B	0.5156
95B	0.3967
98C	0.3967
98G	0.3967

APPENDIX C

F-STATISTIC AS A MEASURE OF VARIABLE INCLUSION

$$F = \frac{\text{RESTRICTED SS} - \text{UNRESTRICTED SS} / R}{\text{UNRESTRICTED SS} / (N - K - 1)}$$

WHERE:

SS = SUM OF SQUARES OF THE RESIDUAL
R = THE NUMBER OF LINEAR INDEPENDENT RESTRICTIONS
N = THE NUMBER OF OBSERVATIONS
K = DEGREES OF FREEDOM IN UNRESTRICTED EQUATION

$$F = \frac{1.11209 - .86903 / 57}{.86903 / 321}$$

F = 1.575 D.F. = 57/321 F IS SIGNIFICANT AT THE 1% LEVEL

(MADDALA, G. S.: 194-199)